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ABIES FIRMA (PINACEAE) NATURALIZED IN NORTH AMERICA

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ABSTRACT

In North Carolina, *Abies firma*, an introduced fir from Japan, is reported as escaping and establishing for the first time in North America. Momi Fir is an infrequently introduced taxon that has been proposed as a highly suitable ornamental tree, particularly in the southeastern United States. This recent discovery of its ability to naturally produce viable progeny suggests that widespread horticultural use of this coniferous species needs further evaluation. A description and photographs are provided to aid in identification of this taxon.

KEY WORDS: Pinaceae, *Abies firma*, Momi Fir, Alleghany County, North Carolina

An unfamiliar conifer was encountered in Alleghany County, North Carolina during the spring of 2010, while conducting an ongoing survey of the vascular flora of the county. Several saplings were noticed in the vicinity of a secluded residence. The estimated age of these individuals varied from small first year seedlings (ca. 5 individuals) immediately bordering the house to 5-8 year old saplings (1-2 m tall; 2 individuals) and larger 15-20 year old (4-5 m tall; 4 individuals) pole-sized trees growing in neighboring woodland margins along a roadside embankment and a powerline corridor (Fig. 1). The initial assessment of this taxon was confounding. All saplings exhibited branchlets with a planar orientation, and long acicular leaves with spinose-bifid apices (Fig. 2). It became readily apparent that these individuals were expressing a dimorphism from the parent tree. Examination of the property revealed only one possible source, a large 22 m (70+ ft) tall species of *Abies* that had shorter leaves with obtuse-emarginate apices (Figs. 3-4).

Identification and taxonomy.

Most *Abies* species, particularly those introduced, are difficult to identify. A combination of sterile branchlets from both older reproductive trees and younger saplings are needed, but ultimately, examination of mature seed cones is critical for the most accurate identification. However, obtaining ovulate cones from *Abies* spp. can be problematic. Seed cones are produced at the ends of the uppermost branches of the tree. The Alleghany County parent tree was free-climbed to about 18 m, and a fully extended, 5.5 m pole pruner was used to obtain branchlet specimens with cones.

Identification was facilitated primarily by the keys in the Flora of China (Liguo et al. 1999), and cross-referenced with several other sources (e.g., Bailey 1924; Rehder 1940; Bailey and Bailey 1976; Warren and Johnson 1988; Eckenwalder 2009). This taxon was determined to be *Abies firma* Siebold & Zucc. (Japanese Fir, Momi Fir) based on the following diagnostic characteristics:

Young leaves elongate with sharp, bifid apices and a 2-ranked/distichous, planar orientation. Older leaves of reproductive branchlets shorter with obtuse-emarginate apices, and a radially spreading or ascending habit. At least some leaves of cone-bearing brachlets with 2 median and up to 2 additional marginal resin canals. Stomatal bands present as abaxial white bands. Buds scarcely resinous. Seed cones yellowish-green, cylindric, 12-15 cm long. Rachis of the seed cone conical and slender. Seed scales thickest at or below the middle, with oblanceolate exserted bracts that have an abrupt apical cusp. Bracts not reflexed. Seeds with a cuneate-oblong wing. Significant features of habit and morphology are illustrated in Figs. 2-7.

Synonymy and voucher information.

Synonymy follows Liguo et al. (1999) and MBG (2010). Common names for the species are Japanese Fir and Momi Fir.

Abies firma Siebold & Zucc., Beih. Bot. Centralbl. 37. II. 113. 1919.
Abies bifida Siebold & Zucc., Fl. Jap. 2(2): 18, pl. 109. 1842. *Abies firma* Siebold & Zucc. var. *bifida* (Siebold & Zucc.) Mast., J. Linn. Soc., Bot. 18(113): 514. 1881.

North Carolina. Alleghany Co.: Cherry Lane Township, Roaring Gap. Located along Lyons Rd. (SR 1102) in the corner of the Oklahoma Rd. (SR 1100) jct. at 36°23'15.57"N, 80°59'51.68"W, elev.745 m. Parent tree planted in the front yard of an old residence with saplings growing in disturbed areas in the neighboring vicinity. Infrequent (11+ individuals). 1 Apr 2010, *D.B. Poindexter 10-13* (BOON, NCU); 7 Apr 2010, *D.B. Poindexter 10-27* (BOON); 9 Jul 2010, *D.B. Poindexter 10-408* with *A.T. Poindexter* (BOON, NCU).

Discussion.

Momi Fir, an endemic of Japan, occurs in warm temperate forests (Vaario et al. 1999). In its indigenous range, the wood has been utilized for various purposes varying from roof shingles, boards, ship building, and matches to musical instruments (Edwards 2008). In the United States, this introduced tree is rare in the nursery trade. Although it has been used in the Christmas tree industry in western states, it is primarily limited to ornamental specimen trees in eastern arboreta (Gilman & Watson 1993).

Abies firma has not been previously documented as naturally reproducing or naturalizing in North America. Nor has it been reported to occur outside of cultivation anywhere else in the world (GCW 2010). To date, the only nonnative species of *Abies* that has been reported for North America is *Abies alba* Mill., European Fir (Kartesz 2010; USDA, NRCS 2010; Weakley 2010). Coincidentally, the documentation of this taxon also is from North Carolina and its occurrence has been traced back to plantings made in the late 1800s (Weakley 2010).

The presence of more than two resin canals in the leaves of *Abies firma* is a strong diagnostic character that can be used to separate it from *A. alba*, among several other relevant taxonomic morphological characters. Likewise, apparently no native species in North America north of Mexico exhibit more than two resin canals in their leaves (Hunt 1993).

The localized naturalization of *Abies firma* in Alleghany County is a consequence of an initial planting that originated well over 75 years ago (J. Hanks, former landowner, pers. comm.). Once established, *A. firma* can grow ca. 30 cm (12 inches) per year (Gilman & Watson 1993). Most firs reach reproductive maturity on average at 20 years of age; however, growth rates are rather slow, especially in the seedling stage (Gilman & Watson 1993; Edwards 2008). This time required for establishment and the subsequent annual growth rate were used as the basis for age estimations of the individuals at this site. Despite the limited area of occurrence, several of the trees appear to be over 10 years old, thus conforming to the criterion of "naturalized" that was formulated by Pyšek et al. (2004).

According to Gilman and Watson (1993), *Abies firma* "is probably one of the best (if not the best) firs to grow in the southeast." The authors likely reached this conclusion based on the high tolerance of heat and drought exhibited by this species suitable for USDA hardiness zones 5B-8, as well as its preference for acidic soils. In contrast, seedlings at this site apparently generated from self-fertilization, which suggests that the population may be genetically unstable and would likely deteriorate over time. Monoecious firs are generally self-compatible, but this form of reproduction has been shown to reduce seed yield in the North American native Noble Fir (*Abies procera* Rehder)

(Edwards 2008). Likewise, offspring derived from self-fertilization often show signs of inbreeding depression, e.g., reduced growth rates (Edwards 2008).

As a result of the recent discovery of Momi Fir in Alleghany County, it seems that unabated commercialized use of this taxon in the southeast could have long-term consequences upon the landscape (i.e., it could become a more prominent ornamental exotic taxon). Ultimately, widespread horticultural use of this taxon needs further evaluation to assess potential broader-scale ecological impacts.

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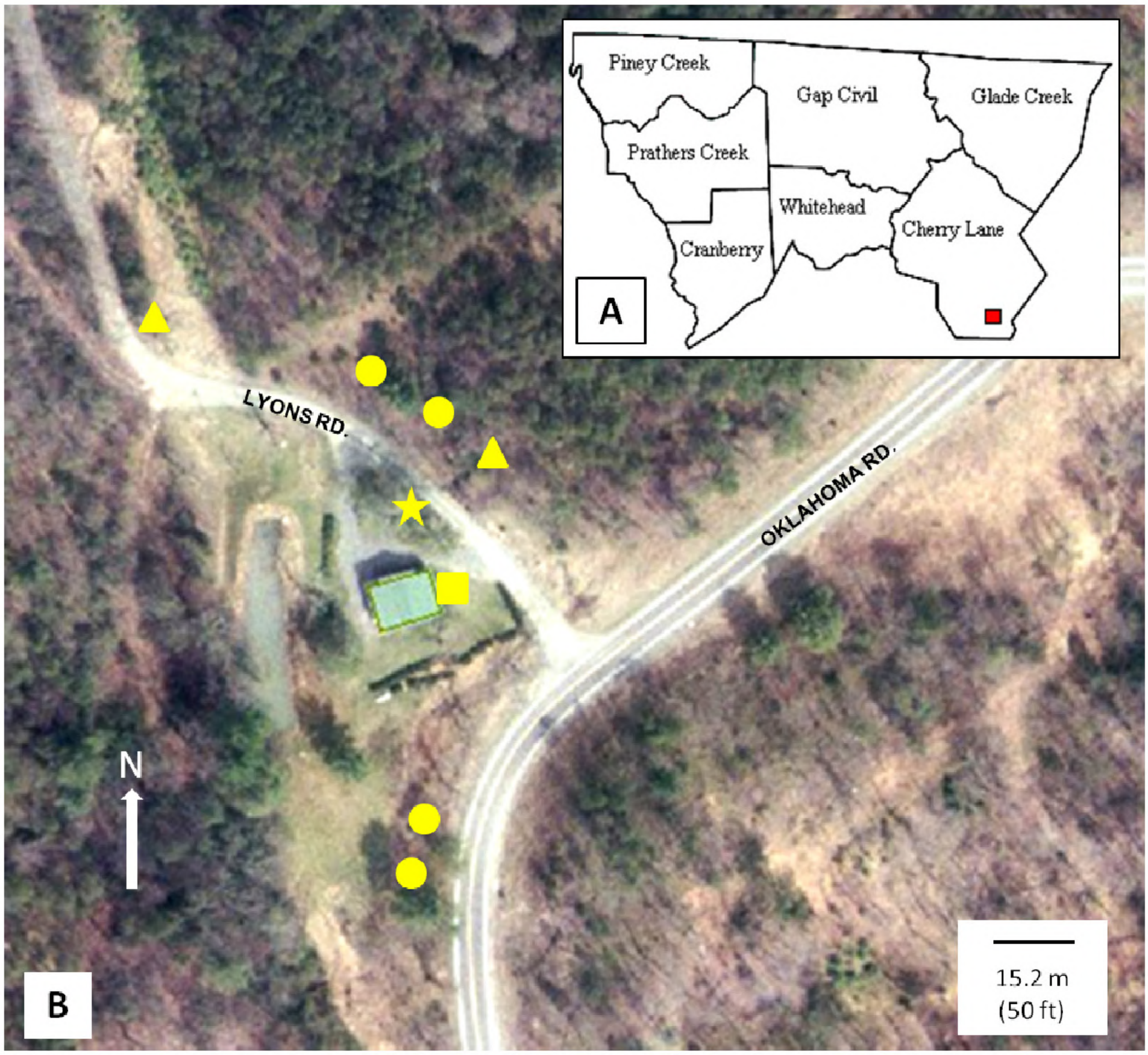

Figure 1. A) Locality of *Abies firma* in Alleghany County, within the Cherry Lane Township (red square), and B) aerial imagery of the site of naturalization. Yellow symbols correspond to parent tree (star), first-year seedlings (squares), 5-8 year old saplings (triangles), and 15-20 year old small trees (circles). Ages of naturalized trees are based on rough estimations.

Figure 2. Branchlets of a vigorous young tree exhibiting different morphological characters than the older, parent tree. Note the sharply pointed, bifid tips of the leaves, as well as their planar orientation.

Figure 3. Image of the parent tree (approximately 22 m tall).

Figure 4. Mature (but unripened) seed cone and branchlets of the parent tree. Note the exserted, non-reflexed bracts of the cone and the short leaves with rounded apices.

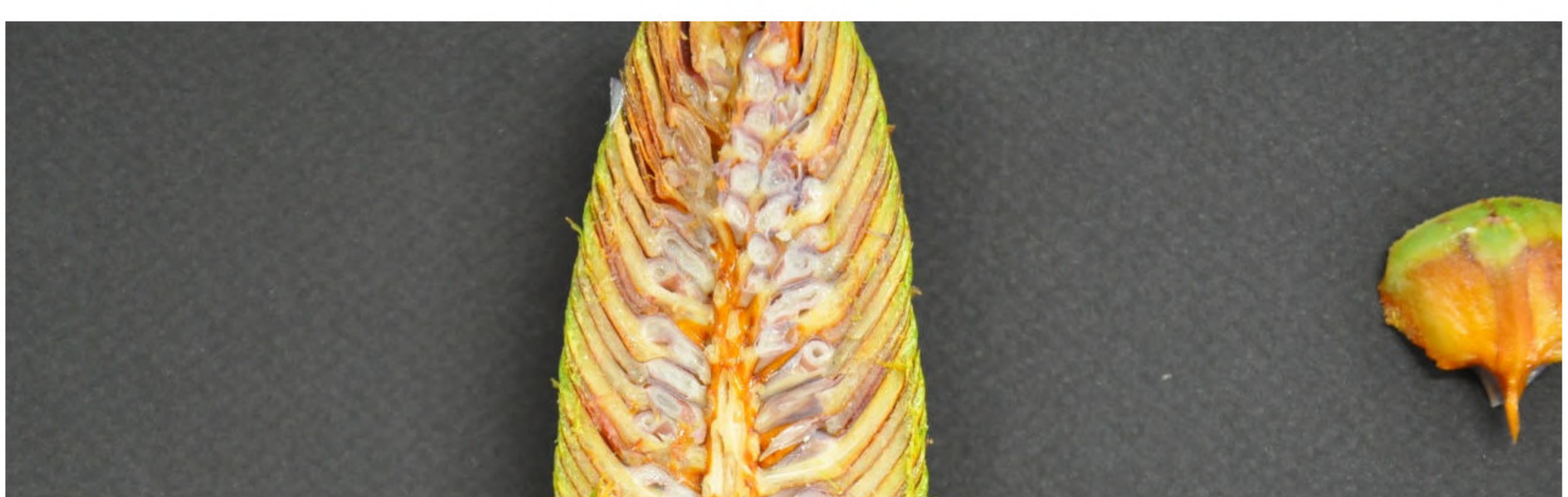

Figure 5. Longitudinal section of a seed cone. Note the thin conical rachis.

Figure 6. Adaxial view of a seed scale, displaying young winged seeds.

Figure 7. Abaxial view of a seed scale. Note the oblanceolate bract with a short apical cusp.